

Phantom midges (Diptera: Chaoboridae) from Burmese amber

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SYNOPSIS. Two new chaoborid species of the extinct genus *Chaobormus* gen. nov. are described based on two males and one female from Burmese amber. Diagnostic features of the new genus are approximated eyes, short R3+4 and M1+2 forks, relatively short Sc and A veins, tibial spurs, tarsomere 1 longer than tarsomere 2, the fifth tarsomere in male simple, undilated, with small simple claws.

INTRODUCTION

There are many peculiarities of the Burmese amber insect fauna. Some groups (for example, Coleoptera) are numerous and even dominant though usually (in ambers from other localities) they are not so abundant (Rasnitsyn, 1996). The composition of the dipteran families in the Burmese amber assemblage (see Rasnitsyn & Ross, this volume) suggests an unusual ecological situation in the Burmese forest.

In order of abundance, the leading families are Empididae (21%), Psychodidae (including Phlebotominae) (17%) and Chironomidae (16%). The dominant position of empidids is recorded otherwise only in the assemblage of Nizhnyaya Agapa locality (lower Upper Cretaceous of Taimyr, North Siberia) where they make up as much as 48% of all the dipterans. From the literature (Larsson, 1978; Zherikhin, 1978; Kulicka *et al.*, 1985) Chironomidae are common in amber, whereas Psychodidae are rare. In the numerically studied collections of fossil resins Chironomidae are usually the most abundant: Nizhnyaya Agapa (Taimyr, Cretaceous) – 30%, Yantardakh (Taimyr, Cretaceous) – 71%, Starodubskoye (Sakhalin, Paleocene) – 77%, Baltic amber – 41% (the latter is calculated from the material collected directly at the Kaliningrad amber-mine, K.Y.Eskov, pers. comm.; other published percentages are biased for the reason explained by Larsson (1978: 89): ‘The Copenhagen collection contains about 900 specimens, approximately 11% of the entire collection, and the museum has been offered at least ten times as many.’). In contrast, numbers of psychodids in the assemblages other than that of Burmese amber is invariably low. Only several psychodid inclusions are found in both Cretaceous fossil resin localities from Taimyr, as well as in the Paleocene Sakhalin amber. In Baltic amber the psychodids represent 2.5% (K.Y. Eskov, pers. comm.). Larsson’s figure for the Copenhagen collection is 4%; in the Baltic amber collection of the Museum of the Earth in Warsaw only Nematocera were counted, not all Diptera, but the numbers are significant: Chironomidae – 2592 specimens, Psychodidae – 262.

One of the Burmese amber rarities is the find of three specimens of Chaoboridae, or phantom midges. A damaged chaoborid male from Burmese amber was first mentioned many years ago and determined as *Chaoborus* sp. by Edwards (1923). He wrote: ‘In size and appearance it differs little from the small species at present existing in India’ (p. 152). Since then this specimen was mentioned in some reviews (Spahr, 1985; Poinar, 1992). Through the courtesy of Mr Andrew Ross (NHM, London) and Dr. A.P. Rasnitsyn (PIN RAS, Moscow), I had an opportunity to re-examine this inclusion. It does not appear to be a member of *Chaoborus* Lichtenstein, 1800, because of the presence of approximated eyes, tibial spurs and a comparatively

short anal vein. The similar, though not conspecific, male and female have also been found in one piece of Burmese amber, showing additional peculiarities in wing venation. All of them are placed in a new genus described below and are housed in the Department of Palaeontology of the Natural History Museum (London).

Chaoborids are very rare in amber and usually family participation doesn’t exceed 0.1% of Nematocera (Kulicka *et al.*, 1985). Only ten specimens of Chaoboridae are known from Baltic amber (Upper Eocene–Lower Oligocene), though thousands of dipterans are described from it or determined at least to the family level. Three of these chaoborid fossils were described at the beginning of our century as extinct species of the recent genera *Chaoborus* (known then as *Corethra*) and *Mochlonyx* Loew, 1844 (Meunier, 1902, 1904). Unfortunately, a holotype female of *C. ciliata* Meunier, 1904 has never been re-examined (and seems to be lost), but two males of *M. sepultus* Meunier, 1902 were redrawn and redescribed by Hennig (1966). Three others are deposited at the Zoological Museum of Copenhagen: one of the specimens was identified, with some reservations, as *M. sepultus* by Hennig, but two remaining specimens from this collection were not determined because of their poor preservation (Larsson, 1978). Three additional specimens are recorded (but not described or determined even to the genera) from the Museum of the Earth in Warsaw and Gdansk (Kulicka *et al.*, 1985). An additional, hitherto unrecorded specimen from the collection of the Department of Palaeontology of The Natural History Museum (London) has been shown to me by A. Ross; this well-preserved specimen (register number II.18) was determined by me as a member of *Chaoborus*. Of course, new records are possible, but the general trend that they are quite rare seems to be clear.

One more chaoborid, *Trichia gracilis* Hong, 1981, was described from Chinese Eocene amber (Hong, 1981). This generic name appears to be a junior homonym and was replaced by *Iyaiyai* (Evenhuis, 1994). Earlier Borkent (1993), in his world catalogue, presumed that this specimen does not belong to Chaoboridae at all: ‘The lack of a plumose male antenna, the peculiar wing venation and wing shape, the strikingly elongate legs and what appears to be a transverse suture on the scutum all suggest that the species does not belong within the family’, but due to absence of an alternative placement ‘the genus remains an enigmatic member of the Chaoboridae’ (Borkent, 1993: 6). *T. gracilis* cannot be assigned to the family because of the above-mentioned characters combined with venation peculiarities which are seen on the published photo (distal shift of all furcations, and posterior M branch aligned to M stem). This specimen belongs to Tipulomorpha beyond doubt, but the proper family identification requires re-examination of the inclusion (densely plumose veins are known in Limoniidae, so it may belong to this family).

There are some other published records of chaoborid inclusions. Two specimens are mentioned in Nizhnyaya Agapa (Taimyr, Cenomanian, Upper Cretaceous) and one more in the Paleocene Sakhalin amber (Zherikhin, 1978); Evenhuis' reference (1994) to Zherikhin & Sukatcheva (1973), concerning the fossil chaoborids found in the Cretaceous Siberian resins is erroneous and should be read as Zherikhin, 1978). After a re-examination the discussed specimen from Sakhalin appears to be one of the numerous chironomids, and one specimen, a poorly preserved male from Nizhnyaya Agapa (PIN N 3624/98) is a ceratopogonid. So the only chaoborid from Upper Cretaceous Taimyr resin (Nizhnyaya Agapa) is a female with the first tarsomere as long as the second, described as *Taimyborus aequiarticulatus* (Lukashevich, 1999). An additional, hitherto unrecorded female has been found in Lower Cretaceous Lebanese amber from D. Azar collection (D. Shcherbakov, pers. comm.).

Chaoboridae are repeatedly mentioned among other Diptera from Saxonian Upper Oligocene–Lower Miocene amber (Barthel & Hetzer, 1982; with a reference to determination by Schumann; Schumann, 1984; Schumann & Wendt, 1989). It was a preliminary determination, and since that time neither further identification nor quantitative composition of the Bitterfield chaoborid assemblage have been published. Perhaps during detailed re-examination they may appear to belong to the Corethrellidae, the family that until recently was usually included with Chaoboridae. Corethrellidae are recorded from Bitterfield as well as from a variety of Cretaceous and Tertiary resins (however, not yet in Baltic amber): *Corethrella cretacea* from Lower Cretaceous Lebanese amber, *C. prisca* and *C. miocaenica* from Oligocene–Miocene Saxonian amber and *C. nudistyla* from Oligocene–Miocene Dominican amber, each species being described based on a single male (Borkent & Szadziewski, 1992; Szadziewski *et al.*, 1994; Szadziewski, 1995).

The above observations indicate that chaoborid inclusions in fossil resins are as rare as that of Corethrellidae. The case of impression fossils is strikingly opposite: not a single corethrellid impression is found thus far, while thousands of chaoborid impressions are collected in numerous Jurassic and Cretaceous localities of Europe and Asia. This contradiction may depend, at least in part, on the habitat preferences by the two midge groups. Extant immature *Corethrella* are most commonly found in small water bodies, for example, in water accumulated in leaf axils, epiphytic plants and tree hollows, the females of some species are blood-feeders on birds and tree frogs (McKeever, 1986). As a result, adult corethrellids are dendrophilous, in contrast to chaoborids which prefer the herbage for resting. Based on study of numerous samples of resins of different living conifers Zherikhin & Sukacheva (1989) infer that 'terrestrial organisms connected with forest vegetation and especially with tree trunks are taphonomically preferred' (p. 91). In other words, being dendrophilous, Corethrellidae have much higher chance than Chaoboridae of being trapped in resin. Hence, even being a rare group in the source biocenosis, they might even outcompete chaoborids as inclusions in fossil resins.

SYSTEMATIC DESCRIPTIONS

Family **CHAOBORIDAE** Edwards, 1912
Genus **CHAOBURMUS** nov.

TYPE SPECIES. *Chaoburmus brevisculus* sp. nov.; probably Late Cretaceous, Burmese amber.

NAME. From genus *Chaoborus* and Burma (now Myanmar).

Table 1 Character states in the genera discussed (apomorphies are in **bold**, E = as in *Eucoethra*, C = as in *Chaoborus*).

Character	<i>Eucoethra</i>	<i>Chaoborus</i>	<i>Chaoburmus</i>
tars1/tars2	>1	>1	E=C
male tars5	swollen	undilated	C
male claw	large, complex	small, simple	C
tibial spurs	present	absent	E
eyes	approximated	well separated	E
clypeus	long	short	C
halter pedicel	with setae	without setae	C
Sc	long	usually long	short
R3+4 fork	>R3+4 stem	>R3+4 stem	<R3+4 stem
M1+2 fork ¹	<M1+2 stem	>M1+2 stem	E
A apex to Rs	distal	distal or proximal	C
A apex to m–cu	proximal	distal	E

¹Polarity doubtful

DIAGNOSIS. Imago. Small densely pubescent midges. Pedicel without setae. 13 flagellomeres, last two being the longest. Eyes reniform, approximated. Clypeus length shorter than the head capsule height. Wing transparent. Posterior wing margin setae long and dense. Sc short, ending somewhat distad of RS bifurcation (level with r–m). Appendix veins (RSa and Cua) absent. R3+4 and M1+2 fork short, shorter than their respective stems. Anal vein entering wing margin proximal to m–cu and RS origin level. Haltere without conspicuous setae. Gonocoxite elongate, with long setae; gonostyle bare, without apical seta. Tibiae with apical spurs. Tarsomere 1 longer than tarsomere 2, last male tarsomere simple, undilated, claws small and simple.

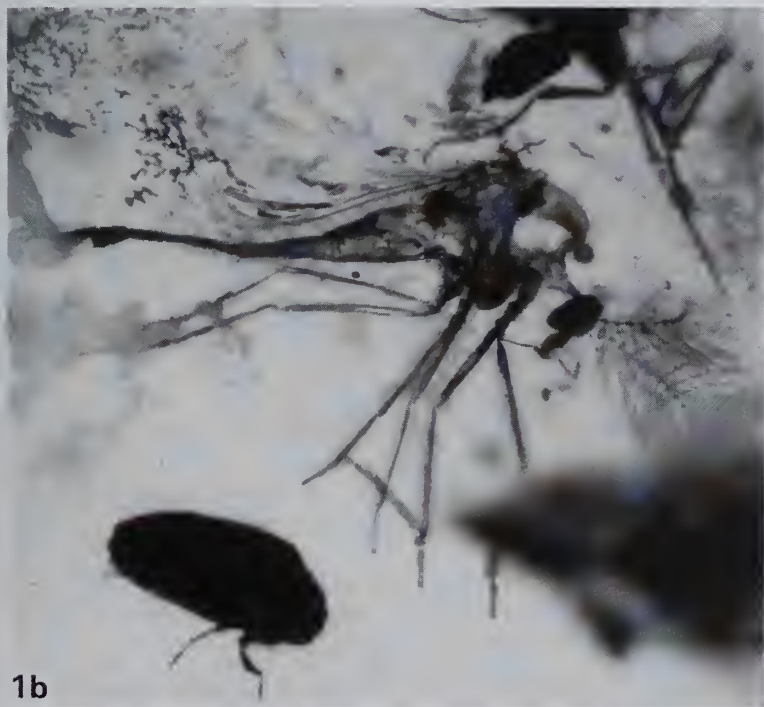
OTHER SPECIES. ?*C. victimaartis* sp. nov. from Burmese amber.

REMARKS. In the ratio of the first to the second tarsomeres, *Chaoburmus* is similar only to two recent genera, *Eucoethra* Underwood, 1903 and *Chaoborus* (character matrix for these genera is given in Table 1; polarity of the characters, except venation, after Saether, 1992), and to all genera described from compression fossils (except those known only from wings: *Rhaetomyia* Rohdendorf, 1962 and *Helokrenia* Kalugina, 1985); from all extinct genera distinct in the short anal vein, and from most of those for which the tarsi are known (*Astrocoethra* Kalugina, 1986, *Baleiomyia* Kalugina, 1993, *Hypsocoethra* Kalugina, 1985, *Mesocoethra* Kalugina, 1993, *Praechaoborus* Kalugina, 1985) also in their structure, being similar in the simple last tarsomere with small claws and presence of tibial spurs only to *Chachotosha* Lukashevich, 1996. The latter differs from *Chaoburmus* in larger size, the apical seta on gonostyle and standard chaoborid venation with long Sc, A, and the R3+4 and M1+2 forks (Lukashevich, 1996). Tarsi are poorly known in *Chironomaptera* Ping, 1928, presumably collective genus widespread in the late Mesozoic of Asia; according to the photographs and drawings of Zhang (1990), in the type species *C. gregaria* (Grabau, 1923) and in *C. vesca* Kalugina, 1980 the last tarsomere is simple with small simple claws, and one apical spur is recorded on the fore tibia in the latter species; *Chironomaptera* is nevertheless distinct from the new genus in the short, rounded or oval gonocoxite and the veins and forks not shortened.

Among extant genera, the anal vein is similarly short (though ending far distad of RS origin) and recorded only for *Eucoethra*, *Chaoburmus* being distinct from it in the structure of claws and last tarsomere and in the absence of dense haltere pubescence. In these latter features *Chaoburmus* resembles *Chaoborus*, but differs from it, besides the anal vein, in the approximated eyes and the presence of tibial spurs (*Eucoethra* possessing a single spur on each tibia). Neither the short R3+4 and M1+2 forks nor the short Sc are typical

for *Chaoborus* and *Eucoethra* (Saether 1970, 1976; the short Sc terminating at r-m level was independently acquired by the only species, recent *C. brevisector* Edwards, 1930). Additionally, *Chaobormus* differs from *Eucoethra* in the smaller size and unspotted wings. These characters are of specific and not generic level in *Chaoborus*, and the same could be true of *Eucoethra* if more than one species were known.

As for the extinct genera, a short M1+2 fork often occurred in the Mesozoic, so with some reservation this character can be considered a plesiomorphy. A short R3+4 fork (shorter than the respective stem) is recorded only in *Baleiomyia discussoria* Kalugina, 1993 (Unda and Daya localities, Transbaikalia, Upper Jurassic-Lower Cretaceous) and *Helokrenia nana* Kalugina, 1985 (Kubekovo locality, Siberia, Middle Jurassic; one more, undescribed fossil tentatively



Figs 1a, 1b *Chaobormus brevisculus* Lukashevich, sp.nov., holotype NHM In.20168, male in Burmese amber; views from opposite sides.



Fig. 2 *Chaobormus brevisculus* Lukashevich, sp.nov., paratype NHM In.20168(1), female in Burmese amber.

determined as *Helokrenia* sp. was found in the Purbeck Beds, England, Lower Cretaceous (Berriasian); Ed. Jarzembowski, pers. comm.). Besides the short, broad R3+4 and M1+2 forks, *Helokrenia* and *Chaobormus* are similar in their small size and short Sc (ending at r-m level), being distinct in the anal vein length. Though the anal vein wasn't figured in the description of *Helokrenia nana* (Kalugina & Kovalev, 1985: 80, fig. 38), it can be seen in the holotype as a long vein ending distal to m-cu as usual. The English specimen possesses a long anal vein as well. The short Sc is characteristic of Jurassic Dixidae (another family of the same superfamily, known since the Jurassic) and the oldest chaoborid, *Rhaetomyia* and therefore considered a plesiomorphy.

Preimaginal stages remain unknown. The combination of other characters is too unusual to assign *Chaobormus* to either Eucoethrinae or Chaoborinae at present state of our knowledge (the balance of possible synapomorphies is in favour of Chaoborinae, see Table 1).

***Chaobormus brevisculus* sp. nov.**

Figs 1-4

NAME. From Latin *breviusculus* – rather short, alluding to the length of first tarsomere compared to the second.

HOLOTYPE. NHM In.20168, inclusion of a well preserved male; Burmese amber; probably, Late Cretaceous (see Zherikhin & Ross, this volume).

PARATYPE. NHM In.20168(1) – a well preserved female originating from the same piece of amber, but now separate.

DESCRIPTION. Small densely pubescent midges with pale legs. Wing unspotted, three times as long as wide, veins with short macrotrichia. R1 slightly displaced forwards, terminating proximad or level with R3+4 furcation. R3+4 fork 2 (female) – 2.5 (male) times shorter than R3+4 stem. Vein r-m aligned with bas M3+4. M1+2 fork 1.5 (female) – 2.5 (male) times shorter than M1+2 stem. Anal lobe somewhat reduced. Gonocoxite approximately 3 times as long as wide, gonostyle about one-third shorter than gonocoxite. At least fore and middle tibia with one(?) apical spur each. First tarsomere 1.1–1.25 times longer than second one.

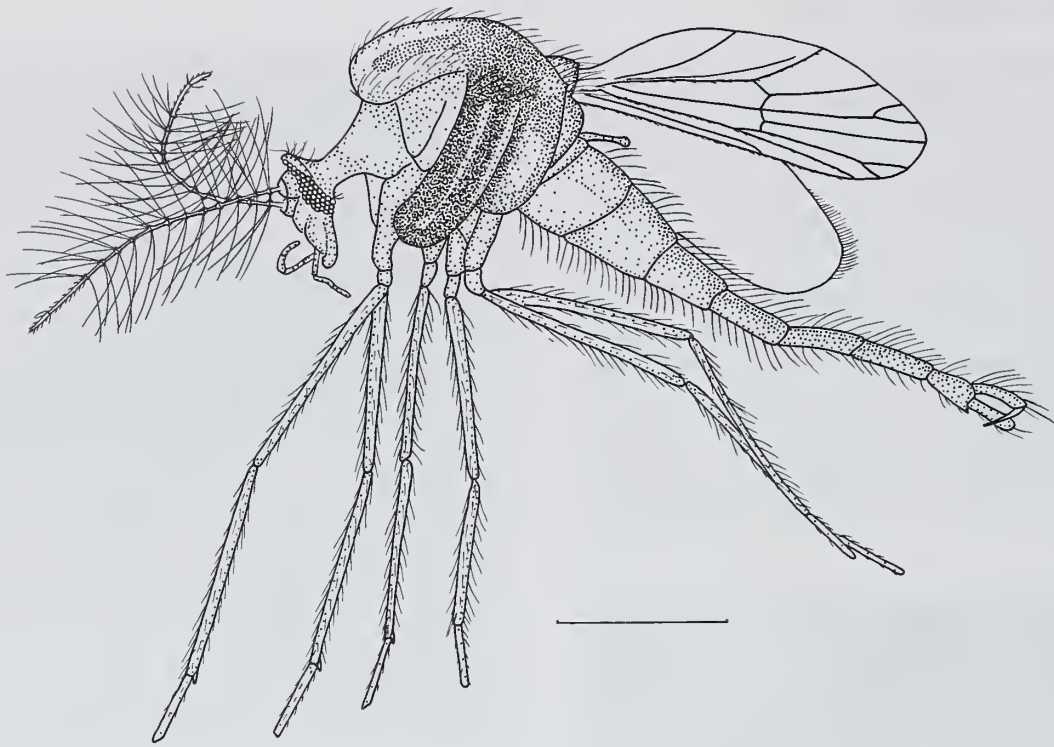
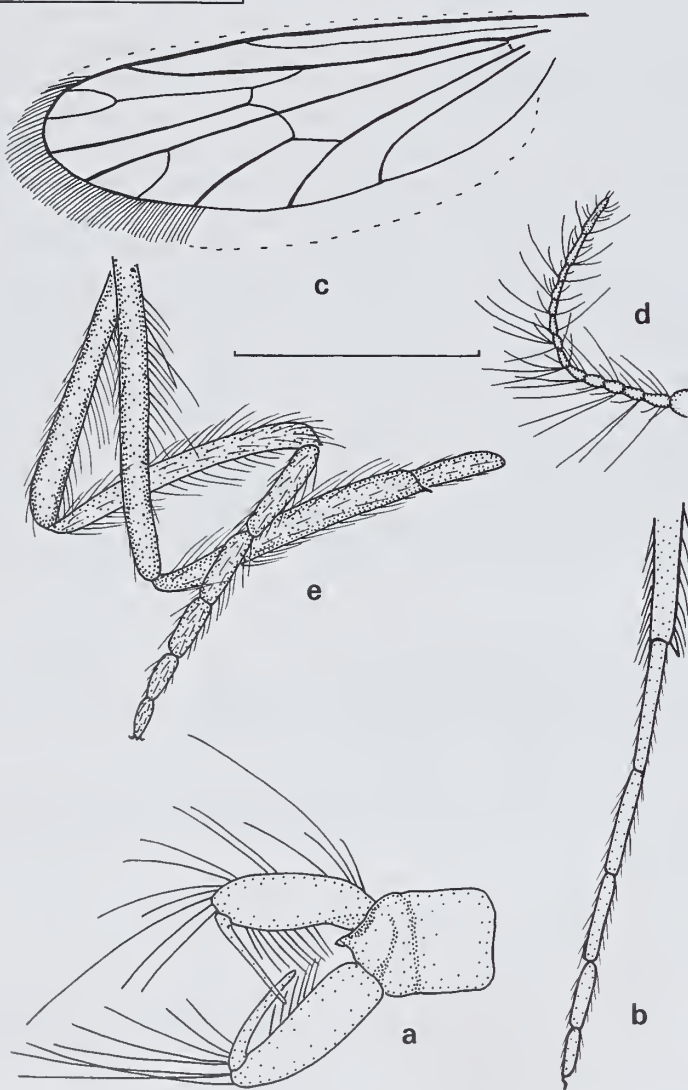


Fig. 3 *Chaobormus brevisculus* Lukasevich, sp.nov., holotype NHM In.20168, male in Burmese amber: total view. Scale = 0.5 mm.



Figs 4a-e *Chaobormus brevisculus* Lukasevich, sp.nov. a, b, holotype NHM In.20168, male in Burmese amber; a, genitalia; b, ?fore tarsus (reconstructed, four distal tarsomeres lie separately). c-e, paratype NHM In.20168(1), female in Burmese amber; c, wing; d, antenna; e, pair of fore legs; scale bar= 0.5 mm.

MEASUREMENTS. Male. Antenna length = 0.83 mm, thorax length = 0.63 mm, abdomen length (with genitalia) = 1.55 mm, wing length = 1.0 mm, wing width = 0.34 mm, fore femur = 0.64 mm, fore tibia = 0.62 mm, fore tarsus = 0.2/? 0.16/0.13/0.1/0.07 mm, middle femur = 0.53 mm, middle tibia = 0.53, middle first tarsomere = 0.2, hind femur = 0.65 mm, hind tibia = 0.61 mm, first hind tarsomere = 0.25 mm.

Female. Antenna length = no less than 0.5 mm, thorax length = 0.6 mm, abdomen length = 1.25 mm, wing length = 1.1 mm, wing width = 0.35 mm, fore femur = 0.62 mm, fore tibia = 0.6 mm, fore tarsus = 0.2/0.17/0.12/0.1/0.1 mm, middle femur = 0.5 mm, middle tarsus = 0.22/0.17/0.15/0.1/0.1 mm, hind femur = 0.67 mm, hind tibia = 0.62 mm, first hind tarsomere = 0.32 mm.

REMARKS. In the ratio of the first to the second tarsomeres and small size *C. brevisculus* is similar *Taimyborus aequiarticulatus* Lukasevich, 1999, from Upper Cretaceous Taimyr resin (Nizhnyaya Agapa locality), distinct in venation peculiarities (in the latter Sc, A, R3+4 and M1+2 forks longer), shorter wing macrotrichia, longer clypeus and the presence of tibial spurs.

The small size, approximated eyes, R1 displaced forward and reduced anal lobe are the characters of *Corethrella* Coquillett, 1902, now separated into the family Corethrellidae mainly on account of the larval peculiarities. *C. brevisculus* differs from this group in the antennal pedicel without setae, two last flagellomeres longest and the tibial spur present on the middle leg.

? *Chaobormus victimaartis* sp. nov.

Figs 5, 6

NAME. From Latin *victima* and *art* – an art victim, alluding to the male posterior part polished away when making a bead.

HOLOTYPE. NHM In.20157, inclusion of a well preserved male without distal abdomen and wing parts, legs partly damaged; Burmese amber; probably Late Cretaceous.

DESCRIPTION. Male. Head broad, pubescent; eyes separated with a little more than greatest pedicel width. Wing unspotted, veins with macrotrichia especially dense on C and RS, forming sparse rows on Sc, M and A. Vein m-cu twice longer than bas M3+4, the latter



Fig. 5 ?*Chaobormus victimaartis* Lukashevich, sp.nov., holotype NHM In.20157, male in Burmese amber.

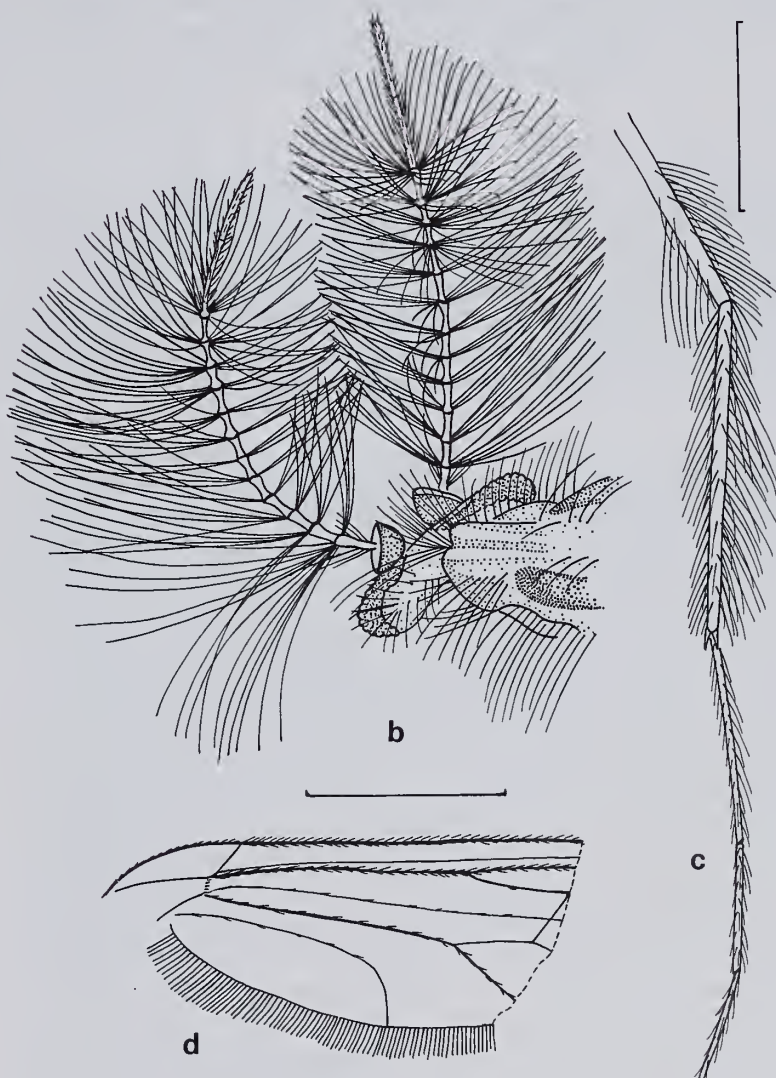
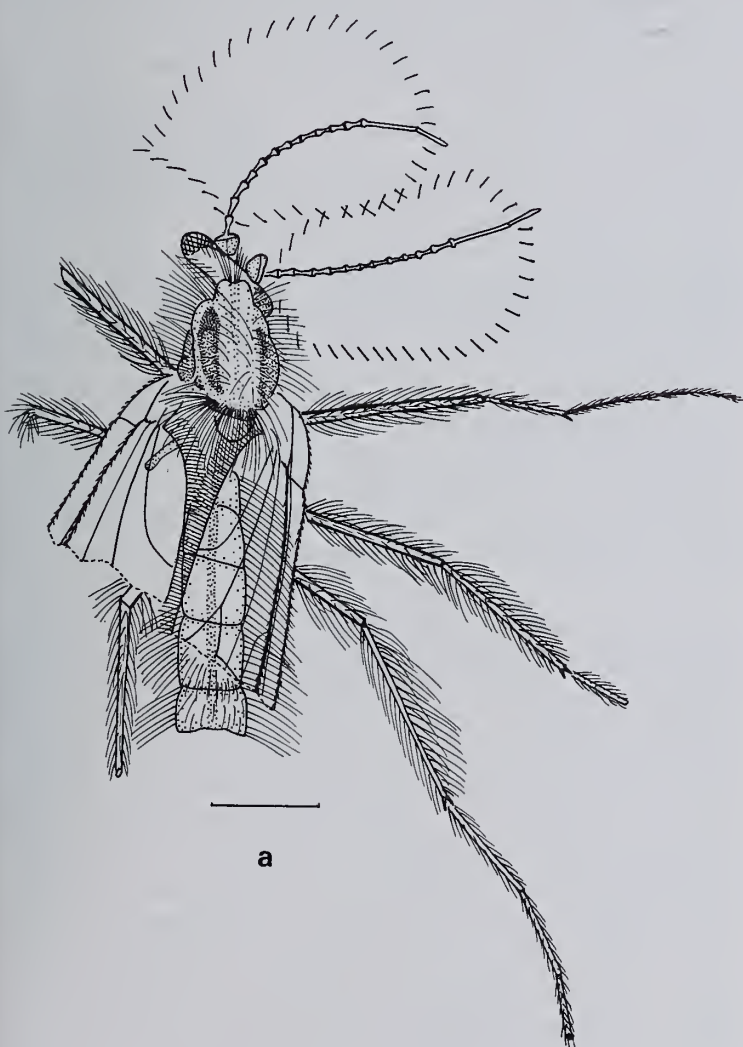
aligned with r-m. Haltere without conspicuous setae: pedicel translucent, bare; capitulum entirely uniformly dark (presence of very short pile cannot be excluded). Parascutellar (postalar) setae present. Tergites are subquadrate. All leg joints dark. Middle and hind legs

with a pair of apical spurs; only one spur is visible on the fore tibia. First tarsomere 1.4–1.5 times longer than second one.

MEASUREMENTS. Total length of inclusion = 2.1 mm; antenna length = 1.2 mm (two last flagellomeres combined = 0.4 mm), pedicel diameter = 0.125 mm, head width = 0.6 mm, width between eyes = 0.16 mm; thorax length = 0.6 mm, thorax width = 0.35 mm, wing width (on level of anal vein apex) = 0.57 mm, fore femur = 0.9 mm, fore tibia = no less than 0.5 mm, fore tarsus = 0.35/0.25/0.2/0.2/0.15 mm, middle femur = no less than 0.8 mm, middle tibia = 0.8 mm, middle tarsus = 0.45/0.3/0.2/0.125/0.125 mm, hind tibia = 0.9 mm, three proximal hind tarsomeres = 0.55/0.37/0.3 mm.

REMARKS. Distinct from *C. breviusculus* in the larger size, wider wings, all leg joints dark, ratio of the first tarsomere to the second one, shape of tergites and, possibly, in the number of tibial spurs. Because of the last feature some doubts remain about the generic affinity of this species.

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Figs 6a–d ?*Chaobormus victimaartis* Lukashevich, sp.nov., holotype NHM In.20157, male in Burmese amber: a – total view, b – head with antennae, c – hind leg, d – wing. Scale = 0.5 mm.

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